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Results of the Project of Capability of Solar Energy Use in Serbia

Technical paper

Energy Efficiency Agency of the Republic of Serbia was realising the project Building capacities for the use and promotion of solar energy in the Republic of Serbia, during, 2008/2010. There were elaborated followed topics:
– Analysis of existing offer and potential demand for solar systems in Serbian market,
– Analysis of institutional, regulatory, normative framework and analysis of possible instruments of financial support,
– Strategic guidelines for solar energy development in Serbia,
– Program of diffusion and training in solar technologies, and
– There were constructed four pilot installations (three photovoltaic plants and one thermal solar system).
The project was financed by the Government of the Kingdom of Spain. The paper brings out results of achieved analyses and presents realised pilot systems.

Key words: *solar energy, photovoltaic, thermal solar*

Introduction

Solar energy is most important energy source at all, but high price of equipment and low efficiency of photovoltaic (PV) conversion were caused disproportion in quantity of installed systems in the world, regarding conventional energy sources. However, the world energy crises and global understanding of it, have caused strong development of the solar equipment industry, and decrease of solar equipment prices.

In 2009 SEEA has start the project "Building Capacities for the use and Promotion of Solar Energy in the Republic of Serbia", with intention to promote and improve use of solar energy in Serbia, taking into account the best world practice. The Project have included activities: analysis of existing offer and potential demand for solar systems in Serbian market, analysis of institutional, regulatory, normative framework, and analysis of possible instruments of financial support, Strategic guidelines for solar energy development in Serbia, Program of diffusion and training in solar technologies and Pilot project construction. The Project was finished at the end of 2010.

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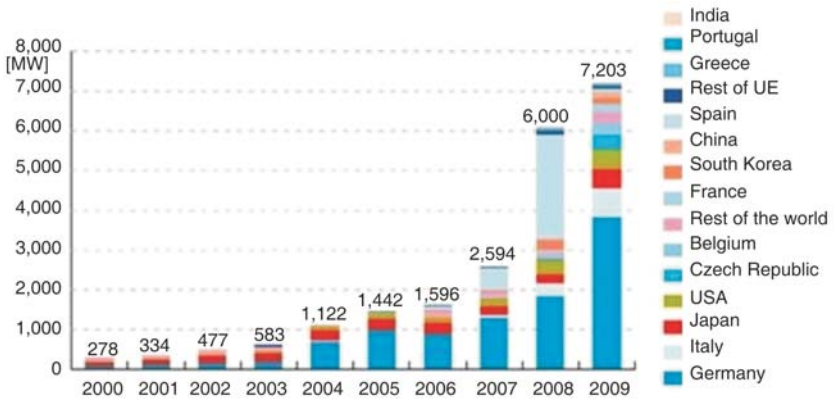

Figure 1. Historical solar PV shipments by region [1]
(full color figure is available in electronic version)

Project activities

Analysis of existing offer and potential demand for solar systems in Serbian market [2]

One of the most important issues for solar energy development is quality analysis of market offer and potential. The main problem for realisation of this study was the difficult access to wide and precise statistics on different fields of study, or even the lack of them. So, used methodologies of analyse were suited to available conditions in the Serbian market.

The potential demand for thermal solar (TS) systems is analysed for the three main sanitary hot water (SHW) consumer sectors: tourism, healthcare, and housing. New housing projections have also been considered for this study.

It has been accomplished an evaluation of the PV power that could be installed and the electric energy of solar origin to be produced in grid connected applications under different scenarios.

Average solar irradiation in Serbia is between 1200 kWh/m^2 on the north part of Serbia up to 1500 kWh/m^2 on the south of Serbia. In order to evaluate the potential demand for TS systems, according to the solar radiation in Serbia, it is assumed that 1 m^2 of solar collector is required for obtaining 65 l/day of SHW, 60 °C temperature.

These data were taken for calculation of potential for solar energy use in Serbia. Table 1 shows results of analysis of potential use of TS energy in Serbia.

Table 1. Potential use of TS energy in Serbia

Sector	Sanitary hot water [million l per year]	Collectors [m^2]	Percentage [%]
Tourism	302.24	12,739.25	0.56
Healthcare	666.84	28,106,106.85	1.24
Existing housing	48,632.45	2,049,840.00	90.5
New housing (2009–2018)	4,138.37	174,430.86	7.70
Total	53,739.90	2,265,116.96	100%

Finally, the estimate of maximum energy saved obtained is 2.812 GWh per year.

The methodology has been used in order to perform the potential demand for PV solar system differs from that adopted for TS ones. In this case, it is not easy to be estimated because, besides technical matters, it involves several factors which are difficult to assess. Therefore, the approach used consists in taking a well-developed PV market as a model and, considering the specific features of Serbian energy sector, to set realistic aims. Figures 2 and 3 show the results of analyses for aggressive and conservative PV market penetration scenarios.

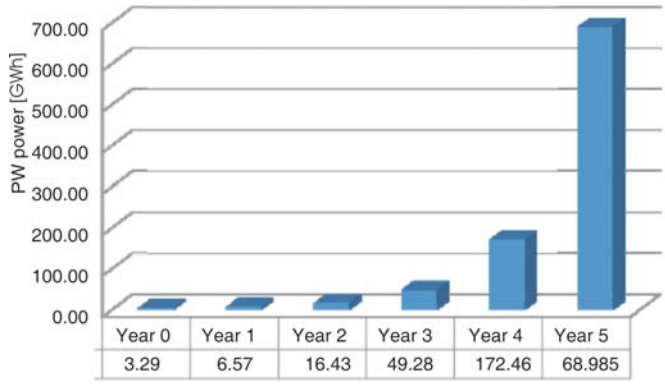

Figure 2. Aggressive PV market penetration scenarios

Figure 3. Conservative PV market penetration scenarios

In the scope to improve communication in the Serbian solar market, SEEA has organised the data base of companies and manufactures engaged in solar energy business. Preliminary, the registration is free as well as the database downloading from SEEA website. Independently of that activity, during the study realisation, there were registered stakeholders in solar business. Summary results are shown in tab. 2.

Table 2. Registered stakeholders in solar business in Serbia

Activity	Number of stakeholders
Registered stakeholders	63
Thermal solar business	49
– Research and development	25
– Projecting	40
– Production	16
– Trade	36
– Montage	39
PV solar business	45
– Research and development	28
– Projecting	39
– Production	16
– Trade	32
– Montage	33

Analysis of institutional, regulatory, normative framework and analysis of possible instruments of financial support [3]

Report of this activity brought wide analyses of regulatory framework in Serbia and presents the most typical samples (the best and the worse) from the other countries. Also, there are detail analyses of effects caused by various programs for solar energy support. In conclusion, there were suggested what should be changed in institutional, regulatory and normative domain, to solar energy use be improved in Serbia.

Main barriers are:

– low price of electricity,
– lack of enforcement to distribution system operators connects such a power plant to their networks as a priority,
– complicated permitting and licensing procedure,
– RES producers have the same obligation as all other producers, despite of the fact that their generation facilities are usually very small,
– feed-in tariffs for solar PV is lower that the Feed-in tariffs for solar PV of the world leading countries, and
– there are no subventions for solar systems constructed for heat production.

The study suggests:

– establishment of the special fund for support the investments in the specified projects,
– introduce the municipal energy managers as it was proposed in the program of implementation for the EE improvement case, and
– incentives for producers and installers of solar energy equipment.

Strategic guidelines for solar energy development in Serbia [4]

Serbia has several strategic documents which promote use of RES, and this study considers them. Also, there are listed main barriers for wider solar energy imple-

mentation. Like in the previous section, there are presented and analysed strengths and weaknesses of some practices in the other countries which has large experience in solar energy use. Based at these analyses, there are proposed activities which should develop solar energy sector in Serbia. These proposals suggest precision activities which should be included in future strategies and programs for implementation of strategies:
– capacity building, training, and public awareness,
– standards and codes adoption,
– demonstration projects,
– research and development programs, and
– financial supporting scheme.

Program of diffusion and training in solar technologies [5]

Serbia has a lot faculties where RES is included in educational programme (Electrical Engineering Faculty in Belgrade, Mechanical Engineering Faculty in Belgrade, Niš and Kragujevac, Faculty of Architecture in Belgrade, Civil Engineering Faculty and the Faculty of Technology in Belgrade, Faculty of Electronic Engineering in Niš, Technical Sciences Faculty in Novi Sad, Agricultural Faculties in Belgrade and Novi Sad, *etc*.; the list is not complete). Besides, the Study proposes wider education programs (trainings) thorough three different axes:
– the level of decision: engineers and architects, economists and personal of the administration,
– the local technicians of assembly and maintenance, and
– the public or the potential users, including the education in the schools.

The Study proposes action plans for realisation, for each of suggested programs.

Pilot project [6]

Within the Project were realised one TS pilot installation and three PV solar plants. Through this part of the Project were achieved followed important effects:
– clean energy productios,
– there was the first time accomplished a new administrative procedure in Serbia, necessary for connection of PV solar plant to electric power system; all administrative stuff and investors can to take it example in the future,
– selected locations for PV solar plant are approx on the North, Central, and South part of Serbia; it will be possible to be compared real energy production for three identical PV solar plant systems, over the different parts of Serbia, through the time,
– TS pilot installation system is installed on Special Hospital "Gorwa Toponica" near to Niš city; social contribution of that equipment is very important, and
– PV solar plants are installed at three secondary schools with technically education profiles, "Mihajlo Pupin" in Kula, "Rade Končar" in Beograde, and "Middle school" in Varvarinne; one of the most important effects is opportunity for practical lessons on real equipment for students; the contract obligation for each of these schools is to enable practical education for all interested school-groups which ask it, from all around Serbia.

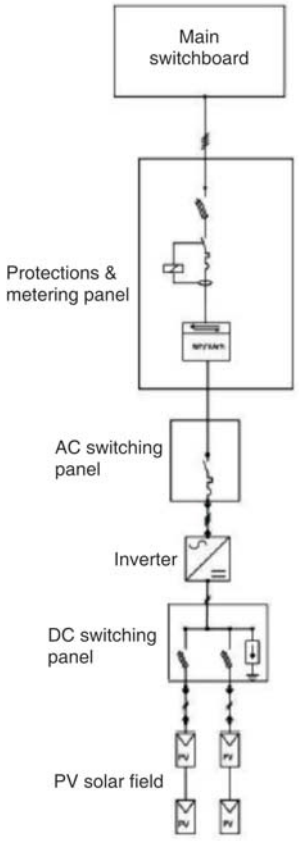

Figure 4. Scheme of PV solar plant installation

PV solar plants

Each PV solar plant is composed of a 5.06 kWp solar field which consists of 2 series of 11 PV modules, and each plant possess a 5.5 kWn three-phase inverter. Tilt angle of every PV module is 35° (±5, oriented to South. All equipment and installation complies highest international standards and Serbian technical rules. Figure 4 shows scheme of installation, and fig. 5 shows details of installed equipment on the schools.

TS system

The TS pilot project is composed of TS collectors, with total collecting surface of 25 m^2, a 2500 l thermal tank (two tanks of 1000l and one of 500l), a 3-way valve for mixing water and all necessary accessories and material for completing the installation. TS collectors are integrated into the roof. 3-way valve is installed for mixing hot water coming from old boiler room and TS water coming from the thermal tanks. The mixed water temperature on outlet is 45 °C. All equipment and installation complies highest international standards and Serbian technical rules. Figure 6 shows scheme of installation, and fig. 7 shows details of installed equipment on the hospital.

Figure 5. Details of installed equipment on the schools from left to right: PV modules; DC switching panel; Inverter; AC switching panel; Monitoring board
(full color figure is available in electronic version)

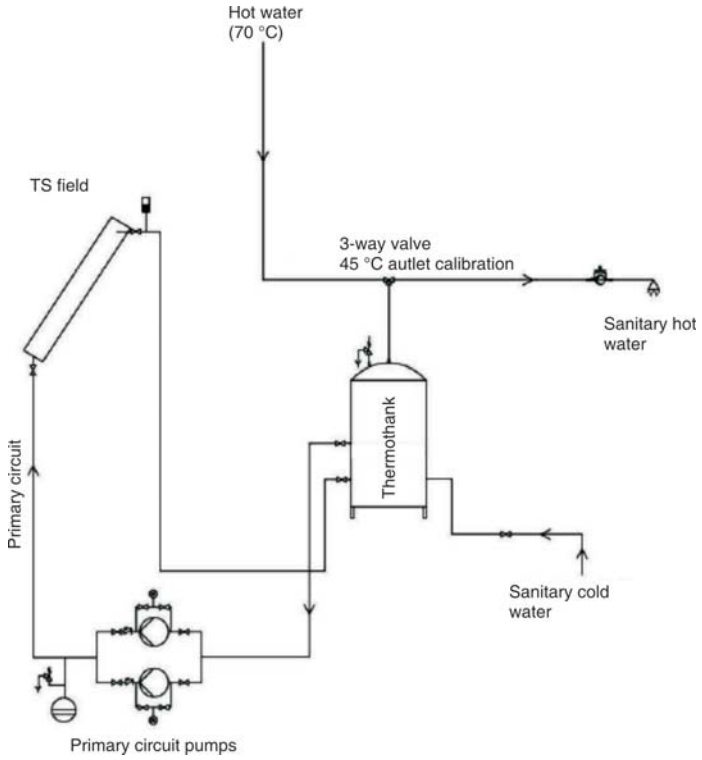

Figure 6. Scheme of TS installation

Figure 7. Details of installed equipment on the hospital from left to right: TS collectors; one tank of 500 l and two tanks of 1000 l; 3-way valve; monitoring system

Conclusions

Realisation of this Project brings wide possibility for future policy orientation and analyses for solar energy use in the future. Expected energy production for each of PV solar plants is about 5.800 kWh, and production of TS system should be less then 15.000 kWh of hot water per year. It is not so large energy production, comparing Serbian global needs, but use of this equipment gives good example for future generation, in which way should be oriented our development and research of the new energy sources.

References

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Апстракт

Растислав КРАГИЋ

Агенција за енергетску ефикасност, Београд, Србија

Резултати пројекта о могућностима употребе соларне енергије у Србији

Агенција за енергетску ефикасност Републике Србије је реализовала пројекат *Развој капацитета за коришћење и промоцију соларне енергије у Републици Србији*, у периоду 2008. до 2010. Реализоване су следеће активности:

– анализа постојеће понуде и потенцијалне потражње за соларним системима на тржишту Србије,
– анализа институционалног, регулаторног и нормативног оквира и анализа могућих инструмената финансијске подршке,
– смернице за стратешки развој соларне енергије у Србији,
– програм популаризације и обуке у области соларних технологија, и
– реализоване су четири пилот инсталације (три фотонапонска постројења и један термални соларни систем).

Пројекат је финансиран од стране Владе Краљевине Шпаније. Рад приказује резултате анализа и реализованих пилот система.

Кључне речи: *соларна енергија, фотонапонски, термосоларни*

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